IN THE SPECIFICATION

Please amend the Specification as follows:

Page 4, first paragraph starting on line 1, please amend as follows:

The above stated objectives are achieved in a method and communications system for modulating and detecting data on a satellite communications channel. A novel combination of quadrature amplitude modulation using a predetermined constellation, and an optimized log-likelihood mapping scheme for detecting points of the predetermined constellation provides optimized bit error rate (BER) ~~BER~~ performance at 3 bits/s/Hz.

Page 9, paragraph starting on line 19, please amend as follows:

The present invention provides a spectral efficiency of 3 bits/sec/Hz at lowered power levels commensurate with new coding techniques such as Turbo Product codes and Low Density Parity Check Codes. A need for a 3 bit per symbol (8 point) modulation scheme that is more robust than conventional 8PSK at low $\underline{E_{bt}/N_0}$ ~~$E_{bt}/N0$~~ has been identified, since error correction coding has improved to the point that it is now necessary not only to look at the bit error rate versus $\underline{E_{bt}/N_0}$ ~~$E_{bt}/N0$~~ of a system, it is also necessary to find a scheme which can be robustly demodulated at the $\underline{E_{bt}/N_0}$ ~~$E_{bt}/N0$~~ target for a selected forward error correction (FEC) scheme.

Page 13, paragraph starting on line 5, please amend as follows:

The output of complex multiplier <u>**31**</u> ~~**32**~~ is coupled to a set of matched filters **32** that extract quadrature (I,Q) channel outputs from the demodulated output signal of mixer **31** and provide them to carrier phase detector **33** and a look-up table **37**. In practice, matched filters **32** are digital implementations and include either A/D converters for accepting an output of mixer **31** or mixer **31** itself is a digital complex multiplier operating on a digital representation of a sampled input signal. Look-up table performs a detection operation on the (I,Q) signals, providing three bit detection probability outputs to turbo product decoder **38**, which provides the final decoded output data. Look-up table **37** provides novel functions within the receiver of the present invention, converting the (I,Q) inputs to a series of coefficients for providing codec inputs to TPC decoder **38**. The coefficients are determined by a log-likelihood mapping of equal probability curves associating I and Q amplitude values with three groupings of points of the QAM constellation employed in modulation scheme of the present invention.

Page 13, paragraph starting on line 24, please amend as follows:

Prior demodulation schemes typically have not employed decoding of the above-described type, as PSK modulation schemes do not typically benefit from such mappings and prior QAM schemes are not advantaged sufficiently by a non-linear detection mechanism so as to justify the cost of look-up table **37**. For example, the depicted embodiment may employ a look-up table having 16 probability levels (4 bits) for each of the 3 grouping decodes. The I,Q input values may be 8 bits each, requiring a 64Kbyte 12-bit memory that has an access time appropriate to the data rate of the system, which is generally prohibitive. Folding techniques may be used to reduce the memory size required by taking advantages of symmetry in the mapping functions, but generally a simplified mapping output is provided rather than a log-likelihood mapping contour as used in the present invention. The particular constellation and mappings used in the present invention provide an advantage when mapped by the log-likelihood look-up table **37**, so that the cost of the above-described memory is justified by an increase in $\underline{E_{bt}/N_0}$ $\cancel{E_{bt}/N0}$ on the order of 0.4dB.

Page 17, paragraph starting on line 5, please amend as follows:

Since the snowflake constellation is rotationally symmetric over π radians as opposed to, for example, π/4 radians for 8 PSK (8 point phase shift-key modulation), the achievable lock stability is greater. The radial amplitude is independent of rotation of the constellation, so the set to which a given constellation point belongs can be determined even when the constellation is rotating (before the carrier loop is locked). The 2 inner and outer points fall on the x-axis when the constellation is locked, and they will therefore be correctly stabilized by a π symmetric detector as described above. An alternative to the above-described phase detector is an I*Q detector, but the described detector that computes Q*sign (I), has greater linear phase range at high $\underline{E_{bt}/N_0}$ $\cancel{E_{bt}/N0}$ and can be implemented using ~~with~~ a simplified inverse circuit rather than full hardware multiply.

Page 20, paragraph starting on line 6, please amend as follows:

Referring now to **Figures 6A-6D**, a mapping for the constellation shown in **Figure 5B** is illustrated. Mapping is the process of coding the 3 bits represented by the constellation signal frames into 1 of the 8 constellation points. There are 8! or 40,320 possible combinations of the 8 points. Gray coding where possible is generally a preferred starting point for determining a mapping. The mapping is selected to minimize the total possible number of bit errors as a function of symbol errors. Within the 40,320 possible mappings mentioned above, 48 have optimal BER properties. The optimum mappings are determined by analyzing the bit error possibilities for a given symbol error rate, when coding 3 bits into 1 of 8 points, as will be described below.

Page 23, paragraph starting on line 15, please amend as follows:

In order to evaluate the efficiency of a constellation it is necessary to estimate the constellation's error performance. This is done by observing the effect of adding Gaussian noise to the In Phase (I) and Quadrature (Q) channels of each constellation (horizontal and vertical axis respectively on the plots). Given a regular constellation, the probability of a symbol error (transmitting a given point from the 8 possibilities and receiving a different one due to additive noise) can be computed from the constellation geometry and the Normal Probability distribution. A mathematical variant of the Normal distribution is used, known as the "Q" function. The Q function gives the single sided probability in the "tail" of the Normal probability curve as a function of a given standard deviation. The Symbol error probability curve is determined by computing the equivalent standard deviation for an 8-point constellation, modified by a Geometry Coefficient which is calculated based on the Euclidian distance from a point to the error threshold. The equivalent standard deviation is calculated as a function of the Energy per Transmitted bit to Noise spectral density, or $\underline{E_{bt}/N_0}$ $\cancel{E_{bt}/N0}$. The Geometry Coefficient

modifies the standard deviation. A larger value of Geometry Coefficient is better, with slight variations being significant as the result is used as an exponent. The equations are as follows:

$$\text{Q function(X)} = \frac{1}{\sqrt{2*\pi}} * \int_{X}^{\infty} e^{-\frac{y^2}{2}} *dy$$

$$\text{Symbol Error Probability} = Q(\sqrt{2*3*\underline{E_b/N_O}\ \cancel{EbtNO} * Geometry\_Coeff})$$

It is then necessary to compute the bit error probability from the symbol error probability. The bit error probability may be approximated by investigating different "mappings".